

HEALTH RISKS DUE TO EXPOSURE TO BIOLOGICAL AGENTS DURING REMOVAL OF ORGANIC WASTE. A SURVEY OF GAPS IN KNOWLEDGE*

Hester R. van Yperen, Angélo L.M. Rutten

BKH Consulting Engineers, Delft, The Netherlands

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Abstract: Following questions in the Netherlands Parliament, BKH Consulting Engineers was commissioned to make an inventory of the information available on health risks due to biological agents during the removal and composting of organic waste. A literature study was performed and experts in the field were interviewed. Four risk groups were distinguished: households, waste collectors, workers at transfer and transport companies, and workers at composting facilities. No information was found on exposure or health effects in households. Though no risks are to be expected, it is recommended to perform an explorative study to confirm the low risk level. It is concluded that exposure of waste collectors may be high, and health risks may exist. It is recommended to study this group further, comparing different techniques of waste collection. Data on workers at composting facilities indicate high exposure to biological agents, and possible exposure related effects. It is recommended to study this group further by comparing different composting techniques. No information was found on exposure and health effects in workers at transfer and transport companies. It is recommended not to study this group separately, but to extrapolate data from the information available for waste collectors and workers at composting facilities.

Address for correspondence: Hester R. van Yperen, BKH Consulting Engineers, P.O. Box 5094, 2600 GB Delft, The Netherlands.

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INTRODUCTION

In the Netherlands, starting from January 1, 1994, it has been compulsory for local governments to collect organic waste separately from other types of household waste. In August 1995, questions in Parliament were directed towards the Minister of Housing, Spatial Planning and Environment (VROM) and the Minister of Health, Welfare and Sports (VWS). The questions concerned health risks related to the presence of moulds and their products in organic waste bins. The concern was based on several publications in non-specialist literature and newspapers, suggesting health effects in people handling organic waste. The Minister of VROM indicated that an

inventory was going to be made in close co-operation with the Minister of VWS and the Minister of Social Affairs and Employment (SZW). Fundamental question of this inventory was: *What are the health risks due to biological agents during the removal of organic waste?* The purpose of the inventory was to indicate whether sufficient knowledge is available to answer the following questions: (1) what are the health risks for the identified groups at risk; (2) which additional research is required; and (3) which measures can be taken to reduce the possible risks. Ministries should be able to translate the results of the inventory into practical measures. The inventory was carried out by BKH Consulting Engineers during January and February 1996.

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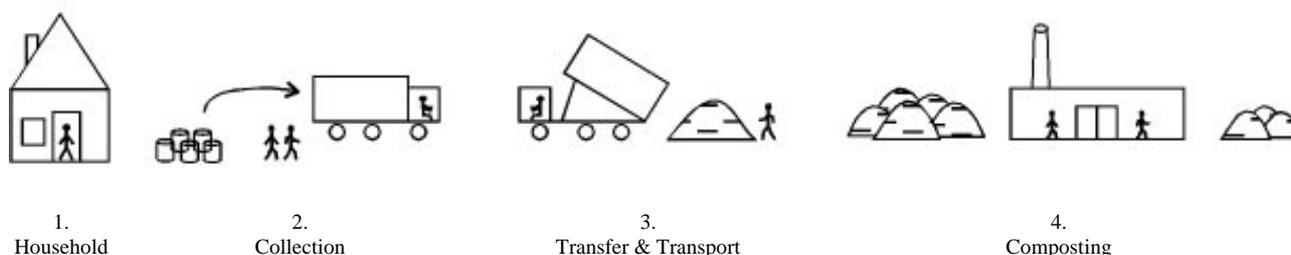


Figure 1. Risk groups in organic waste removal.

MATERIALS AND METHODS

People possibly at risk were identified by making an overview of the process of organic waste removal based on information obtained from several organisations. Four groups at risk were identified: (1) the general public that separates organic waste from other types of waste in their homes (further referred to as households), (2) waste collectors, (3) workers at waste transfer companies and transport companies, and (4) workers at waste composting facilities (Fig. 1). People with malfunctioning immune systems and allergic and asthmatic people form a separate risk group.

For each group, situations with possible exposure to biological agents in organic waste were identified. Also, factors were identified that may influence the growth of microorganisms in organic waste and the formation of decomposition products.

To establish present knowledge, the following sources were consulted: Scientific literature was collected by means of an on-line literature search and by searching files at the Ministries of VROM, VWS and SZW. Also, literature was obtained from several experts in the field. The available literature was screened, divided into categories and presented in a table. Thus, gaps in knowledge can be identified (Tab. 1).

For all four risk groups an inventory was made of:

- data on exposure in several situations;
- measurements of dust, aerosols, fungi, bacteria, endotoxins, glucans and volatile organic compounds;
- factors influencing growth: time, temperature, water activity, pH, oxygen, C/N ratio, competition, substrate;
- reported complaints: malaise, fatigue, headache, fever, muscular pain and joint pain, gastrointestinal complaints, irritation of skin and mucosa, coughing, chest pain, foul smell;
- measured effects: IgG, IgE and eosinophils in serum, asthma, bronchitis, alveolitis, Organic Dust Toxic Syndrome (ODTS), results of lung function tests and skin prick tests;
- special groups with possible increased risks because of immunodeficiency, allergic predisposition etc.

Based on the collected data, statements and provisional recommendations for future research were drafted. Both statements and provisional recommendations have been presented to Dutch experts in the field. An open interview

technique has been used, in which the opinions of experts on statements and provisional recommendations were asked. The experts were also asked to give their opinion on the quality of the available literature and its relevance for answering the fundamental question of the Ministries. Statements and provisional recommendations have been reformulated and final conclusions and recommendations have been made.

RESULTS AND DISCUSSION

The major results from this literature survey are:

- a table illustrating the gaps in the knowledge, i.e. the subjects on which no literature was found (summarized in Table 1);
- a literature list of 45 references (cf. appendix);
- a set of statements and a set of final conclusions and recommendations.

All results are included in a report for the Ministries [1].

No legal occupational exposure limits are available for exposure to microorganisms and their decomposition products. As the relation between exposure to biological agents in organic waste and health effects is not clear, it is not possible yet to draw quantitative conclusions on the health risks due to biological agents during the removal of organic waste. The amount of data is limited, and in some cases the quality of the studies is poor. Furthermore, as stated by the experts, differences in methodology does not allow comparison of the results between studies.

Although exposure to microorganisms may also occur from contaminated skin and clothes, it is striking that inhalation is the only exposure route studied in the available literature.

Because of high variability in exposure measurements, it is not possible to differentiate between exposure to biological agents in organic waste and other types of household waste. This means it is not possible to differentiate between risks related to removal of organic waste and those related to the removal of unsorted household waste. Also, due to the scarcity of data the influence of the factor time (the "age" of the organic waste) on the exposure to biological agents could not be evaluated. This conclusion is quite remarkable, because it is generally assumed that the older the organic waste, the more microorganisms it contains.

Table 1. Summary of availability of literature on health risks for various risk groups: - no references found; * 1-2 references; ** 2-8 references; *** more than 8 references.

		Households		Collectors		Transfer/transport		Composting	
		Organic waste	Other waste types	Organic waste	Other waste types	Organic waste	Other waste types	Organic waste	Other waste types
Exposure situations		-	-	*	*	*	*	**	**
Measurement	Dust	-	-	*	*	-	*	*	***
	Aerosol	-	-	-	-	-	-	-	*
	Fungi	*	-	*	*	-	*	**	***
	Bacteria	*	-	*	*	*	*	**	***
	Endotoxin	*	-	*	*	-	*	*	***
	Glucan	-	-	-	-	-	-	-	-
	VOC	-	-	*	*	-	-	-	*
Factors	Time	*	*	-	-	-	-	-	-
	Temperature	*	-	*	*	-	-	*	*
	Water activity	-	-	-	-	-	-	-	-
	pH	*	-	-	-	-	-	-	-
	Oxygen	-	-	-	-	-	-	-	-
	C/N	-	-	-	-	-	-	-	-
	Competition	-	-	-	-	-	-	*	*
	Substrate	-	-	-	-	-	-	-	-
Complaints	Fatigue, headache	-	-	*	-	-	-	-	**
	Fever	-	-	*	-	-	-	-	***
	Gastrointestinal	-	-	*	*	-	*	-	**
	Mucosal irritation, cough	-	-	*	*	-	*	-	***
	Muscles, joints	-	-	*	*	-	-	-	*
	Foul smell	*	-	-	-	-	-	-	-
Effects	IgG, IgE, eosinophils	-	-	-	-	-	-	-	**
	Asthma	-	-	-	-	-	-	-	**
	Aspergillosis	-	-	-	-	-	-	-	*
	Lung function	-	-	-	-	-	-	-	**
	Bronchitis	-	-	-	*	-	-	-	**
	Alveolitis	-	-	-	*	-	-	-	*
	ODTS	-	-	-	-	-	-	-	**
	Skin prick, histamine	-	-	-	-	-	-	-	**
Increased risk		-	-	-	-	-	-	-	-

Hardly any data are available on exposure and health effects in households. However, experts do not expect the risks in households to be high. Should the Ministries plan to perform further studies, it is relevant to consider the contribution of organic waste to the total exposure to

biological agents and their products in relation to other sources in households.

The few data on exposure and effects during waste collection, as well as the opinion of experts indicate that exposure in this group is expected to be high, and that health effects may occur.

As hardly any data were found on exposure and health effects in workers at waste transfer and transport companies, no conclusions can be drawn. It is to be expected though, that exposure situations in this group are comparable to those in waste collectors and workers at composting facilities.

Most of the available data concern exposure and health effects in workers in waste composting facilities. Not all data concern organic waste. Based on the available data and the opinion of experts, it is concluded that exposure of these workers is high and exposure related effects are to be expected.

As no data were found on groups with an increased risk, no conclusions can be drawn. It is suggested however, that an allergic or asthmatic disposition can increase the susceptibility to effects of exposure to biological agents.

CONCLUSIONS

At this moment it is not possible to draw quantitative conclusions on the health risks of biological agents during the removal of organic waste. Also, it is not possible to differentiate between the risks related to removal of organic waste and those related to the removal of other types of household waste. The influence of the factor time (the "age" of the organic waste) on the exposure to biological agents could not be evaluated. General recommendations include standardisation of research methods of exposure and effects of biological agents; research on the importance of other exposure routes than inhalation; research on the influence of several factors (e.g. time and temperature) on the growth of and exposure to biological agents in biowaste; and the formulation of limit values for the occupational exposure to biological agents and their decomposition products.

More specific recommendations to the Ministries include the following:

Because hardly any data are available on exposure and health effects in households, it is recommended to perform an explorative and practical study in this group. The contribution of organic waste to the total exposure to biological agents and their products in relation to other sources in households should be included.

Although scarce, data on exposure and health effects during waste collection suggest possible health risks in this group. It is recommended to perform further studies. Methods should be used that allow comparison of results to those of other studies being carried out in waste collectors. The studies should be aimed at providing practical solutions for reducing exposure, for instance by comparing different techniques of waste collection.

Hardly any data are available on the exposure and health effects in waste transfer and transport. Because of similarities of operations performed by this group and by waste collectors and workers at waste composting facilities, exposure and effects are expected to be comparable. It is

recommended, for practical reasons, not to study this group separately at the moment, but to extrapolate data from information from (future) studies among waste collectors and workers at waste composting facilities.

Data on exposure and health effects in workers in composting companies indicate that exposure to biological agents is high, and that health effects occur. It is recommended to perform further studies, but these should be directed towards reaching practical solutions and making choices in techniques, rather than towards collection of more numerical data.

In future studies, it is recommended to pay special attention to groups with a possible increased risk.

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APPENDIX

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